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Review Article

A review on *Portulaca oleracea* (Purslane) plant – Its nature and biomedical benefits

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Abstract

This paper is a complete review on an all-important phytochemically rich plant. This is to study its nature and expose its rich biomedical importance and medicinal usefulness for its full exploration in the research community.

Keywords: *Portulaca oleracea*, renoprotective, neuroprotective, benefits, pharmacology, antioxidant, anti-atherogenic

1. Introduction

Once in a while one comes across a plant that is so outstanding that one wonders how on earth it has been overlooked. Purslane (*Portulaca oleracea*) is one such plant. It is commonly called purslane or pigweed in English language, papasan in Yoruba, babajibji in Hausa, ntioke, ntilimoke, ntiike or idiridi in Igbo. *Portulaca oleracea,* is a member of the Portulacaceae family with more than 120 different species. The use of this plant as a vegetable, spice and medicine has been known since the times of the ancient Egyptians and was popular in England during the Middle Ages[33], why it has fallen into obscurity is quite strange. It is fascinating that a plant so prevalent around the world has achieved almost identical recognition in each culture for its benefits.

1.1 Origin

It was first identified in the United States in 1672 in Massachusetts. The name Portulaca is thought to be derived from the Latin 'porto' meaning 'to carry' and 'lac' meaning milk, since the plant contains a milky juice[10]; oleracea from Latin, meaning 'pertaining to kitchen gardens', referring to its use as a vegetable. The use of this plant as a vegetable, spice and medicine has been known since the times of the ancient Egyptians and was popular in England during the middle Ages[33].

Classification

Kingdom	- plantae
Subkingdom	- tracheobionta
Superdivision	- spermatophyta
Division	- magnoliophyta
Class	- magnoliopsida
Subclass	- caryophyllidae
Order	- caryophyllales
Family	- portulacaceae
Genus	- portulacae L.
Species	- Portulacae oleracea L.[50]

1.2 Propagation and distribution

Purslane is distributed all over the world; *Portulaca oleracea* is a herbaceous annual, native of many parts of Europe, found in the East and West Indies, China, Japan and Ascension Island, and though found also in the British Isles is not indigenous there[2]. It is a weedy summer annual species that is abundant throughout the world, invading vegetable gardens, bare areas, low-maintenance lawns, ornamental plantings, and agricultural areas. It is particularly well adapted to the warm, moist conditions found in California's irrigated agricultural and ornamental sites. It has been cultivated in India and the Middle East and has been popular in Europe since the Middle Ages. Common purslane germinates in California from February to March in the southern desert areas to late spring in cooler areas when soil temperature reaches about 60°F. For an early crop, the seed is best sown under protection in early spring and can then be planted out in late spring. Outdoor sowings in situ take place from late spring to late summer, successional sowings being made every two to three weeks if a constant supply of the leaves is required[21].

It germinates very near to or at the soil surface in large numbers after an irrigation or rain. Most of the tiny seedlings die, but the survivors grow rapidly and can produce flowers in a few weeks. The fleshy stems of common purslane can remain moist and viable for several days after cultivation and hoeing, and reroot to form "new" plants when gardens or fields are irrigated. Because of its ability to produce large numbers of seeds, common purslane can rapidly colonize any warm, moist site. It Requires a moist light rich well-drained soil in a sunny position[21,27]. Plants will not produce good quality leaves when growing in dry conditions[21]. The plants take about six to eight weeks to produce a crop from seed and can then be harvested on a cut and come again principle, providing edible leaves for most of the summer[21]. Common purslane is low in stature and forms dense mats. These vegetative mats utilize available moisture and nutrients and screen out light to the soil surface, preventing emergence of other seedlings. Common purslane is unsightly, reducing

the esthetic value of turf and ornamental plantings. In commercial situations common purslane can limit summer vegetable production and reduce the efficiency of harvesting nut crops, such as almonds and walnuts, from the orchard floor.

1.3 Characteristics

1.3.1 Macroscopy: It has a round, smooth, procumbent, succulent stem, growing about 6 inches high, with small, oblong, wedge-shaped, dark-green leaves, thick and stalked, clustered together, destitute of the bristle in their axils which others of the genus have.

The flowers are small, yellow, solitary or clustered, stalkless, placed above the last leaves on the branches, blooming in June and July, and opening only for a short time towards noon. The growth of the plant somewhat resembles Samphire, and the rich red colour of the stems is very striking and most decorative in herb borders.

The reddish stems originate from a central rooting point, radiating out like spokes of a wheel. The stems vary in length, commonly up to 12 inches .The stem succulent, diffusely branched and felt very slippery due to the presence of mucilage when crushed. They are about 2mm in diameter and the internodes are 1.5-3.5cm in length. Nodel appendages are less in number as compared to portulaca quadrifida minute and scarious[14].

Leaves are stalkless (sessile), oval, smooth, succulent, and shiny, and vary from 0.5 to 2 inches in length. The leaves, although generally arranged opposite, very short petiolated, stipular appendages minute or absent, taste sour without any smell, petiole short about 1-1.5mm long and 0.5mm thick with greenish upper surface and reddish lower, may also occur alternately along the stem, particularly near the base. Small (2.67 inch), five-petaled, yellow flowers are borne singly in leaf axils and open only in sunshine. Seeds are borne in a small pod with a top that comes off like the lid on a cookie jar. The seeds of an individual plant have been known to produce both green and golden leaved plants[23].

Seeds are reddish brown to black, oval, and tiny (about 0.02-0.03 inch in diameter). Common purslane is a prolific seeder. A single plant may produce 240,000 seeds, which may germinate even after 5 - 40 years. In late summer, flat mats of mature purslane can be turned over to reveal thousands of seeds on the soil surface[14].

1.3.2 Microscopy: In Transverse section, the microscopic structure of the lamina of *portulaca oleracea* resembles in many aspects to that of *portulaca quadrifida*. The whole mesophyll consists of almost solely of aqueous tissue; the vascular bundles are surrounded by a sheath of green palisade cells as in *P. quadrifida*. The eragstic substance occurs in the form of prismatic and rossets (drugs) of calcium oxalate crystals of different sizes in both species. The leaf of a plant is amphistomatic in contrast to *P. quaudrifida* where it is epistomatic. The number of stomata on adaxial surface is higher than that of abaxial one. Tranverse Section of petiole reveals that the lower surface is comparatively very much bulged, while the upper one is slightly depressed. The uniseriate epidermis is made up of tangentially enlongated tubular parenchymatous cells. The anticlinal wall of lower epidermal cells is curved and cells contain some dark pigment too. Ground tissue comprised of 4-6 layers of thin walled, rounded parenchymatous cells having dinstinct intercellular spaces. The vascular bundle about 2-4 in number are collateral, closed, placed more or less centrally and arranged in an arch which opens towards adaxial side. Vesicles having helical and scaliferous thickenings show simple perforations, fibres often grow intrusively[14].

1.4Composition

Purslane contains more omega-3 fatty acids (alpha-linolenic acid in particular)[8] than any other leafy vegetable plant. Research published by Artemis *P. Simopoulos* stated that Purslane has 0.01 mg/g of eicosapentaenoic acid (EPA). This is an extraordinary amount of EPA for a land-based vegetable source. EPA is an Omega-3 fatty acid found mostly in fish, some algae, and flax seeds[47]. It also contains vitamins (mainly vitamin A, vitamin C, and some vitamin B and carotenoids), as well as dietary minerals, such as magnesium, calcium, potassium, and iron. Also present are two types of betalain alkaloid pigments, the reddish betacyanins (visible in the coloration of the stems) and the yellow betaxanthins (noticeable in the flowers and in the slight yellowish cast of the leaves). Both of these pigment types are potent antioxidants and have been found to have antimutagenic properties in laboratory studies[13].

1.5 Nutritional value per 100 g (3.5 oz)

Energy	84 kJ (20 kcal)
Carbohydrates	3.39 g
Fat	0.36 g
Protein	2.03 g
Water	92.86 g
Vitamin A	1320 IU
Thiamine (vit. B_1)	0.047 mg (4%)
Riboflavin (vit. B_2)	0.112 mg (9%)
Niacin (vit. B_3)	0.48 mg (3%)
Vitamin B_6	0.073 mg (6%)
Folate (vit. B_9)	12 µg (3%)
Vitamin C	21 mg (25%)
Calcium	65 mg (7%)
Iron	1.99 mg (15%)
Magnesium	68 mg (19%)
Manganese	0.303 mg (14%)
Phosphorus	44 mg (6%)
Potassium	494 mg (11%)
Zinc	0.17 mg (2%)[49]

Other constituents include mucilage composed of an acidic and a neutral fraction with structure determined malic and citric acids, dopamine and dopa, coumarins, flavonoids, alkaloids, saponins, and urea among others used[36]. Oxalates and noradrenalin have been isolated from the plant; a new monoterpene glucoside, portuloside A, was isolated from the MeOH extract of aerial parts of *P. oleracea* (collected from Japan)[44]. *Portulaca oleracea* is rich in pectin, glutathione and coenzyme Q10; this palatable vegetable is very well endowed with nutrients and ranks in the top percentile of recommended dietary intake for alpha-linolenic-acid, beta-carotene, tocopherol, magnesium and potassium[56].

2. Benefits of Purslane

2.6.1 Folklore

Purslane in ancient times was looked upon as one of the anti-magic herbs, and strewn around a bed was said to afford protection against evil spirits[24]. It was supposed to protect from evil spirits and if carried was supposed to attract love and luck. It was carried by soldiers to protect them in battle. If laid on the bed, it was believed to protect that person from having nightmares[35]. It is under the dominion of the moon[37] and is supposed to work on the psychic senses and taken regularly helps develop clairvoyant faculties[35]. The infusion may be used to clear the third eye and to wash the crystal ball or scrying mirror[35], no doubt a useful tip for our marketing colleagues! Dioscorides says "it reduces the desire to fornicate". In the latter sense, other authors also mention its anaphrodisiac powers[16], including this plant among the "four cold seeds", together with chicory, endive and lettuce. In Ghana it is an

emblem of peace and is mixed with oil to act as a palliative against evil spirits. It has use in religious ceremonies and in purification after sickness. It is a children's charm for good luck. In Yoruba folklore all the plants of the forest owed money except papas and who paid his debts. Hence the plant features in an incantation for the recovery of owed money, and the Yoruba name meaning 'stick pays'. In Lesotho the plant is a protection against illness and lightening[12]. It is used as a charm by the Suto[53].

2.6.2 General Benefits

The young leaves are a very acceptable addition to salads, their mucilaginous quality also making them a good substitute for okra as a thickener in soups[18,22]. Older leaves are used as a potherb[22]. The seed can be ground into a powder and mixed with cereals for use in gruels, bread, pancakes[18]. The plant is antibacterial, antiscorbutic, depurative, diuretic and febrifuge[11,15,22,32,34]. The fresh juice is used in the treatment of strangury, coughs and sore[15,22,32,34]. The leaves are poulticed and applied to burns[19], both the leaves and the plant juice are particularly effective in the treatment of skin diseases and insect stings[15,11]. A tea made from the leaves is used in the treatment of stomach aches and headaches[19]. The leaf juice is applied to earaches, it is also said to alleviate caterpillar stings[19].

The leaves can be harvested at any time before the plant flowers; they are used fresh or dried[11]. This remedy is not given to pregnant women or to patients with digestive problems[11]. The seeds are tonic and vermifuge[17]. They are prescribed for dyspepsia and opacities of the cornea[17].

To complete the range of its applications, one could mention its use as an insecticide, in which case its juice is poured on to anthills, and also its ornamental use in Roman and medieval gardens[28]. Another authority declared that the distilled water took away pains in the teeth, the seeds, bruised and boiled in wine, were given to children as a vermifuge[36].

In Africa, the whole plant is considered antiphlogistic (takes the heat out) and bactericide in bacillary dysentery, diarrhoea, haemorrhoids, enterorrhaghia. It has been used in prescriptions as an antidiabetic. Externally it is used as a cataplasm of fresh leaves for maturing of abscesses. The seeds are also calmative and will help slake a thirst[9]. An infusion is used as anthelmintic for children to expel roundworms, in high doses as an emetic and also as a cooling drink, with a mild diuretic effect[28].

In Nigeria the plant is used as a diuretic. The bruised leaves are used in external application for erysipelas, treatment of burns and are applied topically to swellings[41]. In Benin area, the plant along with other ingredients is taken as an aid to the development of the foetus[12].

3. Review of research literatures on pharmacological activities of *Portulaca oleracea*

3.1 Anti-microbial activity

Ramesh & Hamumantapa[42] had reported the phytochemical and anti-microbial activity in aerial parts of chloroform and ethanolic extracts of *portulaca oleracea* by agar diffusion method against five bacteria and three fungi (bacteria like *staphylococcus aureus, bacillus cereus, Klebisilla pneumonia,aspergillus niger* and *nerospora crassa*). Ethanolic crude extract showed maximum effect on organisms like *staphylococcus aureus, klebisilla pneumonia* and *neurospora crassa*, Whereas chloroform extract showed moderate effect on *Klebisilla pneumonia, aspergillus niger* and *nerospora crassa*.

The results of this present study supported the folklore usage of the studied plant and suggest that, this plant extract posses compounds which is having antimicrobial agent in the form of drugs for the therapy of infectious diseases caused by pathogens.

Zhao *et al*[57] investigated the effects of *Portulaca oleracea* extracts on growth performance and microbial populations in the ceca of broilers. Results showed P. oleracea extracts have no distinct influence on intestinal pH and that *P. oleracea* extract supplementation significantly altered the cecal bacterial community without affecting the intestinal pH.

3.2 Antioxidant activity

Kamal *et al*[31] had reported the antioxidant activity of *portulaca oleracea* over the different growth stages by using 1,1-diphenyl-2-picrylhydrazyl (DPPH), ferric-reducing antioxidant power (FRAP) assays and ascorbic acid content. There was a correlation between the results of total phenol content 174.5±8.5 to 348.5±7.9 mg GAE/100g and ascorbic acid equivalent antioxidant activity 60.5±2.1 to 86.5±3.9 mg/100 g and between DPPH scavenging IC_{50} (1.30±0.04 to 1.71±0.04 mg/ml) and ferric- reducing anti-oxidant power assays (r2>0.9). The concentrations of Ca, Mg, K, Fe and Zn increased with plant maturity. Calcium was negatively correlated with sodium and chloride, but positively correlated with magnesium, potassium, iron and zinc. It was concluded that mature plants of *portulaca oleracea* had higher total phenol content and antioxidant activities than plants at immature stages.

Agha-Hosseini *et al*[1] evaluated the effectiveness of antioxidant-rich purslane in the treatment of oral lichen planus (OLP). A total of 37 biopsy-proven symptomatic OLP patients were selected for this randomized double-blind placebo-controlled trial. All subjects were divided into two groups to receive purslane (n = 20) or placebo (n = 17) for 3 months. Assessments were made at baseline, after 2 weeks and each month for 6 months, based on the visual analog scale (VAS) and clinical improvement including lesion type and size. Approximately 83% of the purslane patients showed partial to complete clinical improvement but 17% had no response. In the placebo group 17% experienced partial improvement, 73% did not respond and 10% showed worsening. According to VAS scores, a partial to complete response was observed in all purslane-treated patients, while 71%, 15% and 14% of the controls demonstrated partial response, no response and worsening of the symptoms, respectively. A significant decrease in VAS scores was seen at the end of the study period ($p < 0.001$). No serious side-effects occurred in either of the groups. According to their findings purslane is clinically effective in the treatment of OLP. Considering the lack of side-effects during the study period, it may be a favorable alternative treatment for OLP.

3.3 Anti- atherogenic, renoprotective and immune modulatory activity

Rasha and Lamiaa[43] had reported the efficiency of purslane (components of ω-3 and ω-6) on hyperlipidemia, kidney function and as immunomodulators in rats fed high cholesterol diets. The present study showed that 2% cholesterol administration caused a significant increase in total cholesterol, total lipids and triacylglycerol in both serum and liver. Serum phospholipid, LDL-C, and atherogenic index (AI) also significantly increased compared to control group. Cholesterol-enriched diet significantly increased serum urea,creatinine , sodium and potassium levels as well as significantly increased serum IgG and IgM compared to healthy control. Consumption of purslane by hypercholesterolemic rats resulted in a significantly decrement in lipid parameters and significant improvement in IgG and IgM levels as compared with hypercholesterolemic rats. This result suggests that purslane had anti-atherogenic hypolidermic and immunomodulatory effects which were probably mediated by unsaturated fatty acids (including alpha linolenic acid) present in seed mixture.

After spraying of maize plant, during cultivation with 14C-fenitrothion organo-phosphorus insecticide, the obtained seeds contain about 1.6 µg insecticide/g seeds. The effect of subchronic feeding for 45 days of these harvested seeds on rats and the role of natural purslane herb extract in protection against induced toxicity damage were studied. Analytical evaluations were performed by detecting erythrocyte and plasma cholinesterase activities, liver and kidney functions and lipid profile. The assessment of feeding rats with treated seeds after 45 days led to an inhibition in cholinesterase enzyme activity (ChE) over 40% in plasma and erythrocyte. The obtained results showed a significant elevation in the activity of liver enzyme 64% for alanine aminotransferase (ALT), 58% for aspartate aminotransferase (AST) and 35% for alkaline phosphatase (ALP), whereas a moderate decrease in levels of albumin and total protein was observed. A moderate increase in blood urea nitrogen and creatinine concentration was also observed. The detection levels of cholesterol and triglycerides showed a small increase (15%). On feeding rats with obtained maize seeds mixed with purslane herb (*Portulaca oleracea* L) extract led to an increase in cholinesterase enzyme activity, albumin and total protein as well as a decrease in liver, kidney parameters and lipid profile. These data suggest that purslane herb extract have a beneficial effect on reducing the toxicological effects induced by fenitrothion insecticide residues and the protective individual for oxidative stress diseases[38].

3.4 Anti-hyperlipidermic activity

Ahmad *et al*[2] investigated the effect of hydroalcoholic extract of Purslane leaves on serum lipids of rabbits fed with a hypercholesterolemic diet. The serum total cholesterol decreased in all groups treated with purslane extract. It also found that the distribution of cholesterol between lipoproteins were changed, so low density lipoprotein cholesterol (LDL-C) decreased significantly in all of the groups treated with purslane extract with respect to positive control group. All treated animals also showed a decrease in AI. These findings indicate that this plant may be useful for the treatment of hypercholesterolemia.

Sankar *et al*[45] reported the anti-hyperlipidermic activity of ethanolic extract of leaves of *portulaca oleracea*. The ethanolic extract showed a significant decrease in triglycerides ($p<0.01$), LDL ($p<0.01$), VLDL ($p<0.01$), HDL ($p<0.01$), cholesterol ($p<0.01$) respectively. This study revealed that the ethanolic extract showed good anti-hyperlipidemic activity.

Manal and Sahar[39] investigated the effects of purslane, purslane seeds, celery and celery seeds on serum lipids of mice fed with a hypercholesterolemic dietThe study showed that 1% cholesterol and 16% fat administration caused hypercholesterolemia. Induced hypercholesterolemia caused significant increases in body weight, TG, TC (in serum and liver), LDL, Atherogenic index (AI) and decreases in HDL and HTR compared to the control group. Supplemented diet of hypercholestroemic mice with purslane and celery (fresh and seeds) lead to decrease in body weight, TC, TG (in serum and liver), LDL, AI and increase in HTR. 20% purslane and purslane seed were the most effective to reduced TC, TG, LDL, AI and increased HTR ratio. Supplemented hypocholesterolemic diet with 20% purslane fresh and seed caused significant decrease of activity of AST and ALT compared with hypercholesterolemic group. The results revealed that significantly increase $P<0.05$ in liver glutathione of hypercholesterolemic mice fed with purslane and celery (fresh and seeds) when compared to the HC group. This may suggest the supplementation diet with purslane and celery (fresh, seeds) to reduced lipid levels in a hypercholesterolemia disease to prevent from the development the cardiovascular diseases

3.5 Anti- haemoerhoidal effect

Abnormal uterine bleeding (AUB) is a common cause of referral to the gynecology clinic. *Portulaca oleracea* L., commonly named purslane, is used in Iranian folk medicine to treat AUB. To verify this use, ten premenopausal women with AUB comprising menorrhagia, metrorrhagia, polymenorrhea and intermenstrual bleeding who had not responded to standard drugs and were candidates for hysterectomy participated in the clinical trial. Endometrial biopsies demonstrated the etiologies of AUB in six (60%) patients, fibroma; one (10%) patient, endometrial hyperplasia and one (10%) patient, endometrial cyst. Endometrial biopsies of two (20%) subjects were normal. The subjects took 5 g of purslane seeds powder in a glass of water every 4 h orally 48 h after the onset of menstruation for 3 days. The participants were requested to report the effects of seeds powder on the volume, duration and pattern of bleeding. Eight (80%) patients reported that the duration and volume of bleeding had reduced and their patterns of periods had normalized. The seeds powder was ineffective in two (20%) patients. One of the patients had endometrial hyperplasia and the other had fibroma. No adverse effects were reported. AUB did not recur in the patients responding to treatment for the duration of a 3 months follow-up. The results suggest that purslane seeds could be effective and safe in the treatment of AUB[46].

3.6 Anti- arthritic activity

Jagan *et al*[29] had reported the anti-arhtritic activity of petroleum-ether extract of *Portulaca oleracea* Linn by Fruends adjuvant arthritis model in male wistar rats. The test extracts were at the dose of 100,200 and 300 mg/kg/p.o and standard as Indomethacin at a dose of 100mg/kg. A maximum of 77.82% inhibition was observed on 21st day. In a similar fashion treatment with petroleum ether extract also attenuated the increase in paw diameter due to Fruends adjuvant administration, this was more pronounced at 300mg/kg of petroleum ether extract of *portulaca oleracea*. A maximum of 75.69% inhibition was observed on 21st day. This study revealed the anti-arthritic activity of aqueous extract of *portulaca oleracea*.

3.7 Anti- diabetic activity

An *et al*[5] had reported the anti diabetic activity in aqueous extract of *portulaca oleracea* in rosiglitazone induced diabetics . P.oleracea treatment markedly lowered blood glucose, plasma triglyceride, plasma level of LDL- cholesterol and systolic blood pressure in diabetic mice. Furthermore, *Portulaca oleracea* significantly increased plasma level of HDL-cholesterol and insulin level. The impairment of Ach and SNP- induced vascular relaxation of aortic rings were ameliorated by PO treatment in diabetic db/db mice and it also showed that over expression of VCAM-1, ICAM-1, E-selectin, MMP-2 and ET-1 were observed in aortic tissues of untrated db/db mice, which were significantly suppressed by treatment with PO. In this study, it was found that the immune reactivity of the pancreatic islets remarkably increased in treated diabetic mice compared with untreated diabetic mice. Thus they concluded that PO suppresses the hyperglycemia and diabetic vascular inflammation, and prevents the development of diabetic endothelial dysfunction for the development of diabetes and its vascular complications.

3.8 Hepatoprotective activity

The hepatoprotective activity of the aqueous extract of the aerial parts of *Portulaca oleracea* (*P. oleracea*) in combination with lycopene against carbon tetrachloride induced hepatotoxicity in rats was investigated by Anusha *et al*[7]. Both the treatment groups showed hepatoprotective effect against carbon tetrachloride induced hepatotoxicity by significantly restoring the levels of serum enzymes to normal which was comparable to that of silymarin group. Besides, the results obtained from PST and histopathological results also support the study. The oral administration of *P. oleracea* in combination with lycopene significantly ameliorates CCl_4 hepatotoxicity in rats.

Ali *et al*[4] examined the prophylactic and curative effects of purslane extract on bile duct ligation (BDL)-induced liver fibrosis in rats in comparison with silymarin as a reference hepatoprotective agent. BDL significantly increased liver enzymes, total bilirubin (TB) and tumor necrosis factor-alpha (TNF-α) in serum along with malondialdehyde (MDA) in liver tissues. Significant decrease in hepatic antioxidant defense system was noted in BDL-rats. Conversely, administration of purslane reversed all these biochemical parameters which were previously induced by BDL. Considerably, purslane effect was more pronounced in the prophylactic study than that in the curative one. The present work suggested that purslane had prophylactic and curative value on cholestasis-induced liver fibrosis through inhibition of oxidative stress, decreasing the expression of profibrogenic cytokines, collagenolytic activity and activation of hepatic stellate cells.

Sudhakar *et al*[48] investigated the protective role of aqueous extract of aerial parts of *Portulaca oleracea* L. (PO) against cisplatin-induced hepatotoxicity in chick embryonic liver. A dose-dependent increase in biochemical parameters, such as alanine transaminase, aspartate transaminase, alkaline phosphatase, lactate dehydrogenase, malondialdehyde levels and a decrease in antioxidant enzymes levels like superoxide dismutase, catalase, glutathione peroxidase, glutathione reductase, glutathione-s-transferase and reduced glutathione were observed in cisplatin-treated animals, indicating a definite damage to the liver tissue. Pre-treatment with PO extract was found to provide significant protection against cisplatin-induced hepatotoxicity, as evident by the recovered levels of the altered changes in the measured biochemical parameters.

3.9 Nephroprotective activity

Gholamreza *et al*[20] reported the nephroprotective effect of aqueous and ethanolic extract of PO against cisplatin- induced renal toxicity in rats. After 5 days of investigation of the possible protective effect, *portulaca oleracea* was administered as highest dose (0.8 and 2g/kg) for 6-12h before cisplatin injection and had BUN and SCR levels significantly lower than those receiving cisplatin alone. The study concluded that the aqueous extract of PO possesses marked nephroprotective activity and could have a promising role in the treatment of acute renal injury induced by nephrotoxins, especially cisplatin.

Walaa *et al*[51] reported the effect of gentamicin (80 mg/kg Bw/day) without or with oral administration of aqueous purslane (*Portulaca oleracea*) extract (400mg/kg BW/day) and fish oil (5mg/kg BW/day) co-treatments for 15 days in adult male rats (80-120g). There was a decrease in plasma levels concentration of urea, uric acid and creatinine, In addition to decreasing in activities of GSH, SOD and CAT as well as an increasing in MDA concentration in the kidney as a result of gentamicin injection. Co-administration of aqueous purslane extract and fish oil was found to improve the adverse changes in the

kidney functions with an increase in antioxidants activities and reduction of peroxidation. This proposes that dietary fish oil or purslane extract supplementation may provide a cushion for a prolonged therapeutic option against GM nephropathy without harmful side effects.

3.10 Neuronal activity

In order to evaluate mechanisms of natural plant purslane herb aqueous extracts (PHAS) for neuroprotection, the neuroprotective effects of PHAS at doses of 2.5, 5 and 10 mg/(kg day) on SD mice injected daily with D-gal (50 mg/(kg day)) by behavioral tests were observed. PHAS-fed mice showed higher activity upon induction by new environmental stimuli, lower anxiety and higher novelty-seeking behavior in the open field tasks, and significantly improved learning and memory ability in step-through compared with D-gal-treated mice. The mechanisms involved in neuroprotective effects of PHAS on mouse brain were further examined. PHAS significantly increased superoxide dismutase (SOD) activity and decreased the malondialdehyde (MDA) level. Meanwhile, PHAS also could up-regulate telomere lengths and telomerase activity in PHAS-fed groups. Furthermore, we examined the expression of p21 (waf1) and p53 mRNA and protein in mouse brain by western blot analysis and real-time RT-PCR. We found that p21 (waf1) was down-regulated by PHAS without changing the expression of p53. The results of this study suggested that the PHAS might be a primary target of p21 (waf1) and the neuroprotective effect of PHAS might be carried out through a p21 (waf1)-dependent and p53-independent pathway[25].

The neuronal activities of *P. oleracea* were investigated in adult rats by Ahmed *et al*[3]. Purslane was able to induce a significant decrease in calcium concentration of the brain cortex. Dopamine, norepinephrine and serotonin were significantly altered in the studied brain regions after treatment of rats with purslane. Acetyl cholinesterase was increased in all brain regions except in the cerebellum. The results suggest the potential role of purslane mediated changes in the neuronal tissues. In this investigation there was significantly decrease in the Ca2+ level in cerebral cortex by about -25.2% at $p<0.05$. There was significantly decrease in dopamine content (31.2) in spinal cord. There was significantly increase in dopamine content in cerebellum, cerebral cortex, thalamus and hypothalamus of rats. However significant decrease in norepinephrine content in of spinal cord and mid brain, where in 5-HT serotonin significant increase in ($p<0.05$) pons (42.9), cerebral cortex (103.9), while significant decrease in spinal cord by -32.4%. This study concluded that the potential role of purslane for neurotransmitters which is an intergral part of many neurodegenerative disorders

Wanyin *et al*[52] had reported the neuroprotective activity of oral administration of PO extracts The results concluded that the degrees of brain inflammation were reduces sue to administration of PO extracts and also enhanced the increment of PFK, PK and LDH and lessened the decrement of ATP.

3.11 Anti-nociceptive and anti- inflammatory

Jagan *et al*[30] reported the anti-nociceptive and the anti-inflammatory activities of the petroleum ether extract of *portulaca oleracea*. The petroleum ether extract exhibited significant inhibition of the acetic acid- induced writhing, it reduced the paw- licking response time significantly in the formalin test and it increased the withdrawal latency time in the tail immersion test. The Carrageenan induced hind paw oedema was significantly reduced in rats. By this study they concluded that the petroleum- ether extract of PO had potential anti-nociceptive and anti-inflammatorey activities.

Huang and Dong[26] evaluated the protective effect of purslane on the acute injury caused by intra-colonic administration of trinitrobenzenesulfonic acid (TNBS) in rats. Rats treated with purslane (5 and 10 g x kg(-1)) were significantly healthier than TNBS-alone rats, as shown by improved food intake and reduced diarrhea, corrected the disorders in morphology associated to lesions, significantly reduced myeloperoxidase (MPO) levels. Purslane exerts protective effect in experimental colitis; the effect seems to be related to relieving inflammatory reaction and repairing lesions.

4. Dosage of Purslane

The amount of purslane being used depends on the condition(s) being treated. Many practitioners recommend 9-15 grams of dried purslane, or 30-60 grams of fresh purslane for oral administration and the expressed juice from 1 to 2 fluid ounces or as an infusion of the leaves and seeds. Larger amounts can be grounded into a paste to apply to the skin .The herb abounds in a milky juice. A paste is made of it with gokhru, kakdibij and javakharis used in gonorrhoea, scanty urine etc; dose is 2 to 3 ounces [40]. It is used in treating bacillary dysentery and dysuria, in a dose of 250g of fresh plant decoction. The juice extracted from 100g of pounded fresh plant and diluted with water serves as an anthelmintic. It is administered in the morning for 3-5 days [55].

5. Toxicology

Purslane is accused of poisoning sheep and cattle [6]; it is found to contain up to 9% oxalic acid (dry weight) and prolonged ingestion of the plant was stated to cause incoordination of gait and tetanic conditions in sheep. Further experiments, in which three sheep were fed purslane containing 6.1 and 3.5% oxalic acid dry weight failed to produce any disorders in calcium metabolism analyses but post mortem findings were described[54]. Oxalates and nor-adrenaline have also been isolated from *P. oleracea* indicating a possible hazard in the taking of its teas[6].

6. Conclusion

Looking at the extravagant all- round uses of *Portulaca oleracea*, one would not hesitate to conclude that this is indeed a wonder plant. It will indeed be the life saving plant of the 21st century if well harnessed. The nature and benefits of this plant herein exposed is a wake- up call to researchers in pharmacognosy and traditional medicine to do more in its exploitation to decrease human decreptitude.

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